Physics 136a, Week 2: Geometric Viewpoint & Kinetic Theory

(Dated: October 6, 2011; due **Monday October 17, 2011**)

The maximum number of points you can get for this assignment is **75**, although you could choose to do problems that worth more than 75 points. Note the usual due date for this problem set!

This week, we studied special relativity and kinetic theory. This corresponds to Secs. 2.6 – 2.13 and Secs. 3.1 – 3.5 of Blandford and Thorne (BT).

1. Exercise on index manipulations: Exercises 2.5 and 2.8 of BT. [15 Points]
2. Doppler Shift Derived without Lorentz Transformations: Exercise 2.11 of BT. [15 Points]
3. Spacetime Diagrams: Exercise 2.14 of BT. [15 Points]
4. Electrodynamics in special relativity. [20 Points]

   The electric and magnetic field "vectors", **E** and **B**, in electrodynamics are not components of 4-vectors, but instead components of the electromagnetic field tensor, **F**. This is described by Sec. 2.11 of BT. Read that section, and do Exercise 2.20.
5. Stress Energy Tensor of a Perfect Fluid: Exercise 2.26 of BT. [15 Points]
6. Regimes of Particulate and Wave-like Behavior: Exercise 3.3 of BT. [15 Points]
7. Observations of Cosmic Microwave Radiation from Earth: Exercise 3.6 of BT. [20 Points]
8. Equation of State for Relativistic, Electron-Degenerate Hydrogen: Exercise 3.9 of BT [15 Points]
9. Specific Heat for Phonons in an Isotropic Solid: Exercise 3.11. [25 Points]